agricultural research

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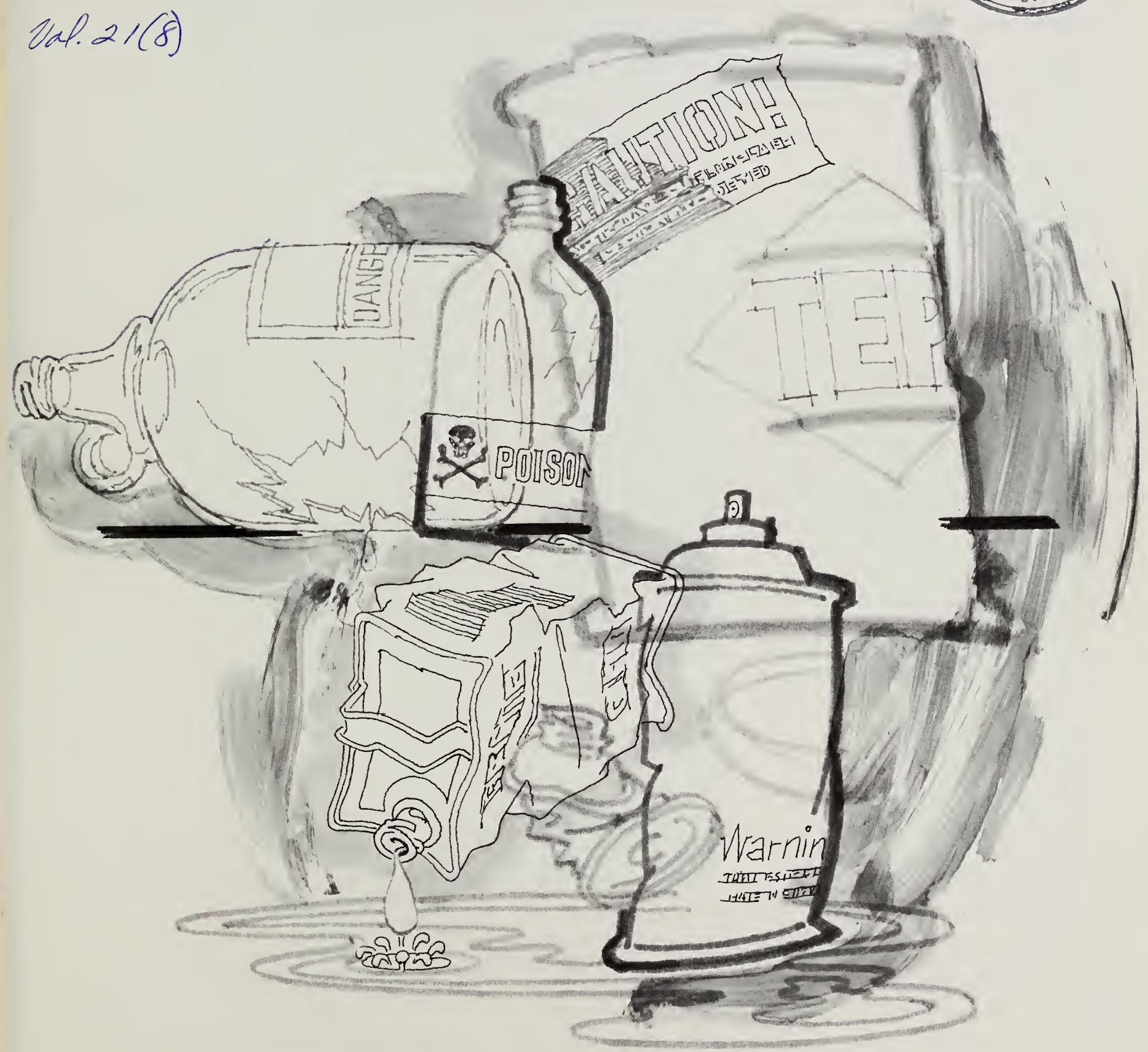

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Winged Nations

The taste of honey, the smell of wax—these gifts of the honey bee belong to a timeless heritage. Its known beginnings trace to a Spanish rock painting of Paleolithic times which depicts a honey gatherer climbing to a wild hive while the bees swirl about menacingly. Later, people of the Bronze Age used wax in casting ornaments and weapons. With the advent of managed apiaries, beehives supplied nations not only with an important part of their food, but also with mead for drink and candles for light.

But of all the good things the honey bee brings to man, none is more important than the gift of pollination. In visiting flowers over vast acreages of forages and other field crops, fruits, and vegetables, little *Apis mellifera*, the honeymaker, does a job that neither man nor machine can duplicate. Some 90 U.S. crops with a total annual value of $6 billion either require or benefit from bee pollution. Alfalfa exemplifies this dependency. Without pollination by the honey bee there would be no alfalfa, the forage crop that underpins our dairy and livestock industries.

Pollination suffers, however, unless the beekeeping industry itself thrives. Accordingly, ARS scientists at seven laboratories conduct basic and applied research on a wide range of bee topics. In disease research they have provided beekeepers with antibiotic treatments that control two former ravagers of hives—American foulbrood and nosema. Now pathologists are seeking ways to control European foulbrood and the paralysis virus.

Significant progress has also been made in bee breeding, especially the development of a better way to artificially inseminate queens. Scientists who heretofore were limited to working with only a few lines and generations a year, can now greatly accelerate the breeding and selection of bees. An outgrowth of this research is a line of bees tailormade to pollinate a specific crop, alfalfa. This is a boon to alfalfa seed growers in regions where other plants compete for the bees' services. Specialized bees will eventually be bred for other important crops.

A few of the other ARS bee research projects include finding ways of preventing bee losses to pesticides, cutting honey production costs through mechanization, and managing bee colonies for better pollination. Research will foster the well-being of the golden "hive-people," long celebrated in poem and prose for their industry and their remarkably organized society and economy. The welfare of these hard-working insects is of inestimable concern to mankind.

Editor: *R. P. Kaniuka*
Editorial Assistant: *M. J. Phillips*

Contributors to this issue:
R. C. Bjork, G. B. Hardin, W. W. Martin, M. E. Nicholas, M. S. Peter, E. L. Razinsky, N. E. Roberts, D. M. Webb, L. C. Yarris

COVER: Recognizing that used pesticide containers may still be lethal, safe disposal of these containers is a must. See story on page 8.

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U.S. Department of Agriculture

Talcott W. Edminster, Administrator
Agricultural Research Service

Toward sun-proof limas

Dr. Abdul-Baki and biological aide Virginia Rosenkranz grind bean embryos with mortar and pestle to extract protein. The embryos have been fed for one hour on radioactive amino acids. In that time the embryos converted the radioactive material to protein which will then be analyzed (0972W 1305–10).

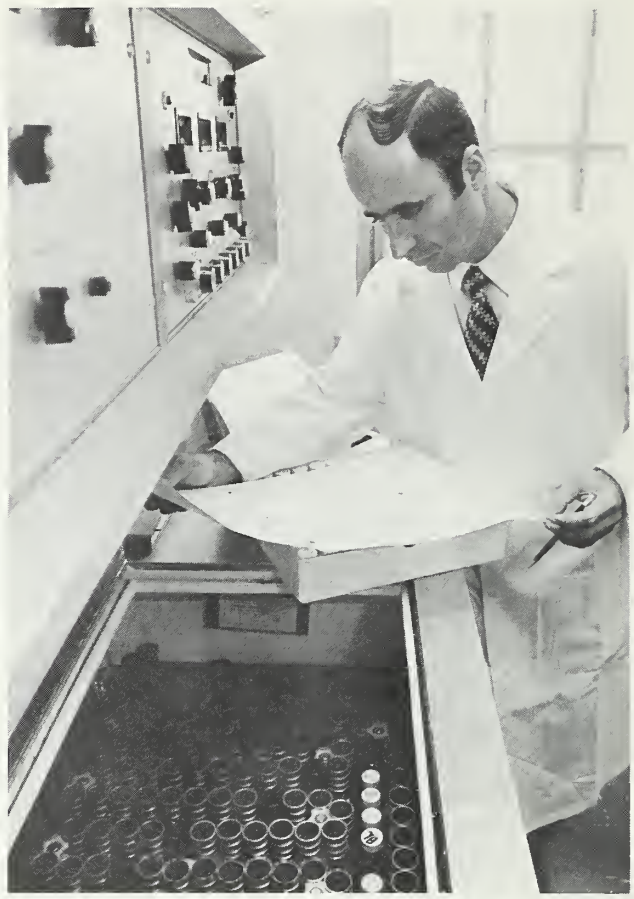
LIMA BEANS bleached by sunlight lose not only their attractive appearance but, equally important, most of their carotene—a major source of Vitamin A. They also lose their ability to produce sufficient proteins and carbohydrates for vigorous seed germination.

These losses have been identified in experiments by plant physiologist Aref A. Abdul-Baki at Beltsville, Md. His findings suggest that future grading standards could be devised to place greater emphasis on the nonvisible qualities of lima beans. At present, lima bean quality is evaluated simply by visual inspection. Beans that have lost their attractive green color are downgraded.

Dr. Abdul-Baki found that specific nutritional and seed-quality factors can be identified and quantified, thereby providing useful criteria for both grading operations and plant breeding programs to improve the crop. Although the Beltsville findings are limited to lima beans, they may have similar implications for peas and some other crop susceptible to bleaching by sunlight.

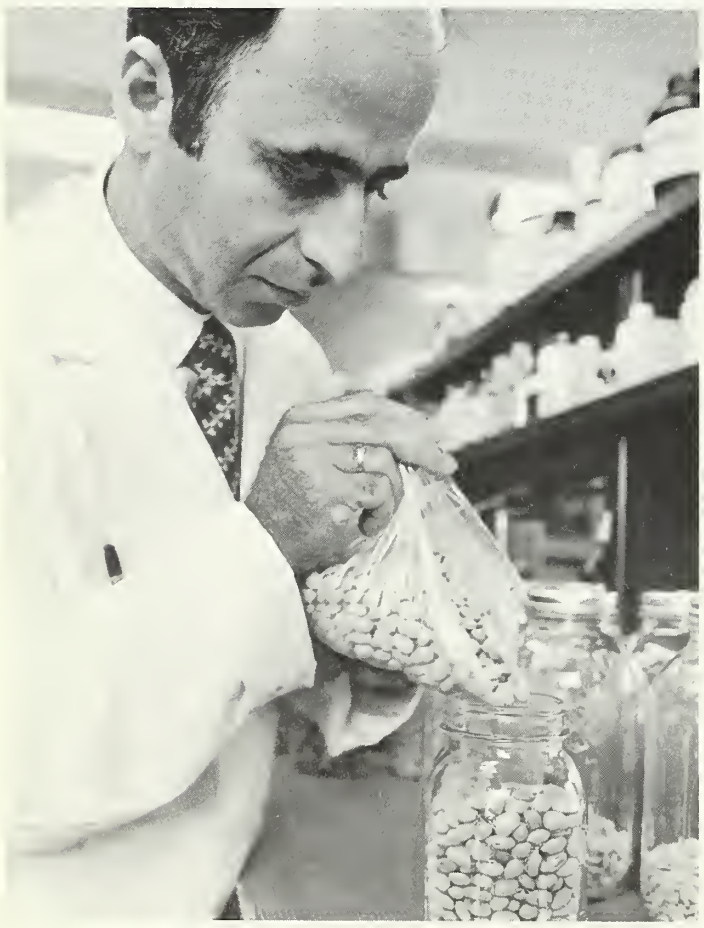
All green-seeded varieties of lima beans are subject to bleaching as they mature on the plant after reaching full size. Some 30 to 60 percent of the lima bean seed crop consists of bleached beans, which must be sold at a discount.

Lima bean seeds are graded on the assumption that a loss of chlorophyll, or green color, goes hand-in-hand with loss of vigor. However, Dr. Abdul-Baki's studies show that seed greenness should not be taken as an index of vigor. He



Above left: *Under controlled greenhouse conditions, breeding studies are conducted to incorporate nutritional and vigor factors—high protein and carotene—into new lima bean varieties. Here, Dr. Abdul-Baki and research technician Vansie Blount evaluate growth performance of some of the crosses (0972W1305–23).* ***Above center:*** *Virginia Rosenkranz separates embryos for testing by radioisotope to determine their capacity to synthesize carbohydrates and protein (0972W 1306–17).* ***Above right:*** *Dr. Abdul-Baki studies a "print-out" from the liquid scintillator that detects radioactive amino acids and sugars which are converted into protein and carbohydrates by the embryos (0972W 1307–23).*

Dr. Abdul-Baki pours lima beans into airtight containers to maintain constant moisture levels during storage prior to studies of vigor (0972W1307–17).



found that damage to seed vigor caused by bleaching results in a loss of the seeds' ability to manufacture sufficient proteins and carbohydrates during germination. This loss may occur independently of a loss of chlorophyll.

Dr. Abdul-Baki developed a simplified laboratory procedure employing a radioisotope detection system that measures synthesis of proteins and carboydrates by seed samples. The potential advantage of this procedure over visual evaluations is supported in other studies of seeds stored under poor conditions—high temperature and moisture, which destroy seed vigor but not their greenness. Dr. Abdul-Baki's methodology would demonstrate loss of vigor in such green seeds.

Moreover, his approach would prove valuable when visual evaluations are not feasible, as with many varieties of naturally white lima beans which, although lacking chlorophyll, are just as vigorous as green-seeded varieties.

Lima beans grown for freezing or canning are graded partly on the basis of their greenness. Loss of greenness has been associated with overripening. Dr. Abdul-Baki's nutritional studies show that loss of nonvisible carotenes is as important as chlorophyll losses, and perhaps more so, from a food quality standpoint. Bleached lima beans lose 90 percent or more of their carotenes.

In searching for a solution to these losses, Dr. Abdul-Baki screened about 150 groups of imported and domestic lima beans obtained from other countries. He found two groups, from Colombia and Bolivia, that contain 14 to 18 times as much carotenes as is found in commercial varieties grown in the United States. These South American beans may thus be of major value in plant breeding programs to enrich the carotene content of present varieties.

In further research to prevent seed bleaching, Dr. Abdul-Baki is studying chemical treatments that could be applied to the beans to arrest losses of their nutrients and vigor. □

SUPPOSE you could make soft drinks nutritious as well as refreshing without appreciably increasing their cost or lowering their taste appeal. Suppose further that this added nutrition was in the form of protein isolated from whey, a byproduct of cheese manufacture, which is now largely wasted and could seriously pollute our streams.

Sounds like a way to combat malnutrition—especially among the young, "chips-and-soda" set—and help avoid pollution at the same time, doesn't it?

Chemists Virginia H. Holsinger, Linda P. Posati, E. David DeVilbiss, and Michael J. Pallansch, of the ARS Dairy Products Laboratory, Washington, D.C., have achieved some encouraging success in adding proteins isolated from cottage cheese whey to carbonated and noncarbonated beverages.

This research opens new possibilities for the nutritional fortification of widely used snack beverages if the whey proteins can be concentrated commercially at a reasonable price.

Whey contains proteins and other nutritious elements in highly dilute form. It is produced in prodigious quantities—9 pounds of liquid whey for every pound of cheese made—which adds up to 1.5 billion pounds of whey solids a year. In spite of whey's potential value, not nearly enough applications have been found to use it all.

Also prodigious is the production of soft drinks in the United States—almost 75 billion 8-ounce bottles every year. That's enough for about a bottle a day for every man, woman, and child. Children and teenagers, of course, drink more than their share of these beverages. To the extent that they pass up milk and fruit juices for soft drinks, they are replacing dietary nutrients, such as calcium and protein, with "empty" calories.

If soft drinks are so popular, the ARS researchers reasoned, why not fortify them with nutritious protein? The cottage cheese whey proteins are well suited for this, since their slightly acid taste enhances the tangy flavor of most soft drinks. Besides, this acid whey has been used less than the sweet whey from other cheeses because of special problems encountered in processing and drying the cottage cheese byproduct.

In isolating the protein from cottage cheese whey, ARS scientists used two filtration processes to remove the salts and most of the lactose, or milk sugar, which represents about 65 percent of the solids in cottage cheese whey. When the resulting protein solution was condensed and dried, it contained over 80 percent protein and only about 10 percent lactose.

Several flavors of soft drinks were fortified with 2.3 grams of whey protein per 8-ounce bottle. After storage at room temperature for a year, the fortified carbonated beverages retained excellent clarity and color. For the first 200 days the flavor also remained unchanged, although a slight whey taste could be detected at the end of the year. These are excellent keeping properties, since 90 percent of all carbonated beverages are sold within 30 days of bottling.

Whey protein was also incorporated at the ARS Dairy Products Laboratory into seven flavors of the popular "ade" drinks that are sold as powder to be mixed with water at home. These beverages, when reconstituted, contained 0.5 or 1.0 percent protein. They were submitted, along with controls containing no protein, to a taste panel of experienced dairy product judges. The judges could detect the whey proteins, even at the 0.5 percent level, but none of them thought that the taste was objectionable. In general, the citrus-flavored fortified drinks scored better in taste than those with noncitrus fruit flavors. □

Aerial view of the semicircular plots used for the sludge application studies taken after the sludge was applied, but before planting. Plots all slope toward the holding pond at upper left (0572K730–23).

City sewers may feed the land

Sewage sludge is being incorporated into trenches four feet deep and two feet wide (BN–39814).

SEWAGE SLUDGE for land improvement?

It's possible, says soil scientist John M. Walker at the Agricultural Research Center in Beltsville, Md. Sewage sludge, the precipitated solid matter removed at sewage plants during processing of waste water, is very difficult to dispose of. Cities consider safe disposal a major problem; in many cases, a critical one.

Preliminary studies by ARS and cooperating agencies showed that trenching to incorporate sludge into the soil can be a practical and acceptable way to dispose of the wastes, with beneficial effects on both soil and crops, and with little harm to the environment.

So far, the scientific team, led by Dr. Walker, found little evidence of groundwater contamination with disease-causing organisms, or with excess nitrates. This was in spite of the fact that the sludges were applied at rates as high as 500 dry tons per acre.

Scientists say that liming the sludge to a pH of 11.5 or higher killed most of the pathogenic organisms. Liming has the added advantages of greatly reducing odors and helping to dewater the sludge. It is also expected to reduce the danger of heavy-metal toxicity to plants.

As yet, the team has found no evidence of heavy-metal toxicity in the grasses, legumes, vegetables, and fruit trees grown in the sludge-treated fields. This probably reflects the fairly low heavy-metal content of the predominantly domestic sludges used in the tests; industrial wastes usually contain the greatest amounts of such heavy metals as zinc, copper, nickel, lead, and chromium.

The scientists express a note of caution on these results with pathogens, nitrates, and heavy metals. They point out that the findings are based on a pilot study of 6 months, and that results may differ with longer periods of application.

This study was initiated last fall in

Above: *Microbiologist Wylie Burge is taking groundwater samples from sludge-treated area for analysis. Assisting is Dale Mosher, technician, Maryland Environmental Service (0472K519–7).* ***Right:*** *Rye on the left was grown in soil mixed to a depth of two feet with no sludge added; on the right, mixed to the same depth but with 80 dry tons of sludge per acre added (PN–2826).* ***Below right:*** *Rooting patterns of sludge–nourished corn are studied in profile by Dr. Walker and soil scientist Elliot Epstein (1272X1569–4).*

response to the specific needs of a sewage treatment facility operated by the District of Columbia. Area authorities, looking for safe and effective means of getting rid of some 300 dry tons of sludge every day, asked ARS and other agencies for technical assistance. Work on the problem was begun, and is still continuing, by a team of soil scientists, microbiologists, agronomists, plant physiologists, engineers, and biological technicians.

The experiments were conducted on a 75-acre plot on generally infertile sandy and clay soils. Some of the sludges were rototilled or plowed into the soil. Others were buried in trenches 2 feet wide and up to 4 feet deep and covered with a 1-foot layer of soil. Consulting engineers designed sealed contained transport systems and all-weather application machinery to permit efficient, clean, large-scale use of the technique.

A second phase of the work is continuing along several lines—on improved methods of application, management of land after sludge application, chemical and microbiological behavior of various sludges in the soil, and prolonged effects of growing crops in treated soils. Studies on the heavy metals are also being expanded.

Principal cooperators with ARS in these studies are the Maryland Environmental Service; Bureau of Wastewater Treatment of the District of Columbia; and the Environmental Protection Agency.

Also cooperating are the Maryland Departments of Water Resources and Health; University of Maryland; government of Prince Georges County, Maryland, and Fairfax County, Virginia; National Park Service; and USDA's Soil Conservation Service. ARS members of the team are associated with the Agricultural Environmental Quality Institute's Biological Waste Management Laboratory, located at Beltsville. □

Safe disposal for pesticide containers

THIS NATION'S collection of used pesticide containers are much more than a monumental pile of junk. In addition to the aesthetic and environmental blight they present, many pesticide containers, while considered empty, still contain enough chemicals to be potentially dangerous.

Safe and economic disposal of pesticide containers is the goal of ARS–supported projects at the Mississippi Agricultural and Forestry Experiment Station, State College. The Mississippi scientists doing the work are agronomist Boris J. Stojanovic, agricultural engineer Fred L. Shuman, Jr., and biochemist Maurice V. Kennedy.

According to the ARS representative on the project, plant physiologist Charles R. Swanson, several disposal-decontamination approaches were considered: biological, chemical and thermal.

The researchers concluded that thermal disposal—incineration—was the best immediately available means for solving this pollution problem.

The problem here is two-fold—the containers themselves and their residual contents. An estimated 130 million containers are used nationally each year for agricultural pesticides and an additional 100 million aerosol cans are used for pesticides around the home. In a Mississippi study, the breakdown of different containers for that State went like this: 65,750 fifty-five gallon drums, 16,000 thirty-gallon drums, 240,000 five-gallon cans, 401,000 one-gallon containers (glass, metal, and plastic), 35,000 half-gallon plastic containers, and 80,000 one-quart containers.

The other part of the problem is the fact that "empty" containers are simply not empty. A Canadian study indicated that an average of 2.7 percent of the pesticides remained in 5-gallon round cans, and averages of 2.2 and 2.8 percent of the original contents were recovered from 1-gallon and half-gallon rectangular containers.

Applying these results to the Mississippi example, and using an average 2.5 percent residue, then the amount of pesticides remaining in discarded containers would have amounted to about 100,000 gallons in 1968, and 143,000 gallons in 1969.

A wide range of disposal methods are currently in use. The Mississippi survey revealed that 18 percent of used containers are burned, 17 percent are left at the city dump, 15 percent are kept on the farm, 13 percent are sold either to the public or to businesses specializing in reconditioned and used containers, 9 percent end up on trash piles, 10 percent are crushed, and 7 percent are returned to the dealer.

Of those retained or sold, many are reused as garbage cans, water barrels, spray machine tanks, floats for rafts, and animal feed troughs.

At present, relatively few incinerators can accept and decontaminate an intact 55-gallon drum. The need for shredding before incineration will add significantly to the bulk and cost of disposal systems.

Under the ARS grant, Mississippi scientists are testing a prototype of a proposed incinerator. Special design features include a "scrubbing" system for cleaning the gasses produced in burning the chemicals and containers.

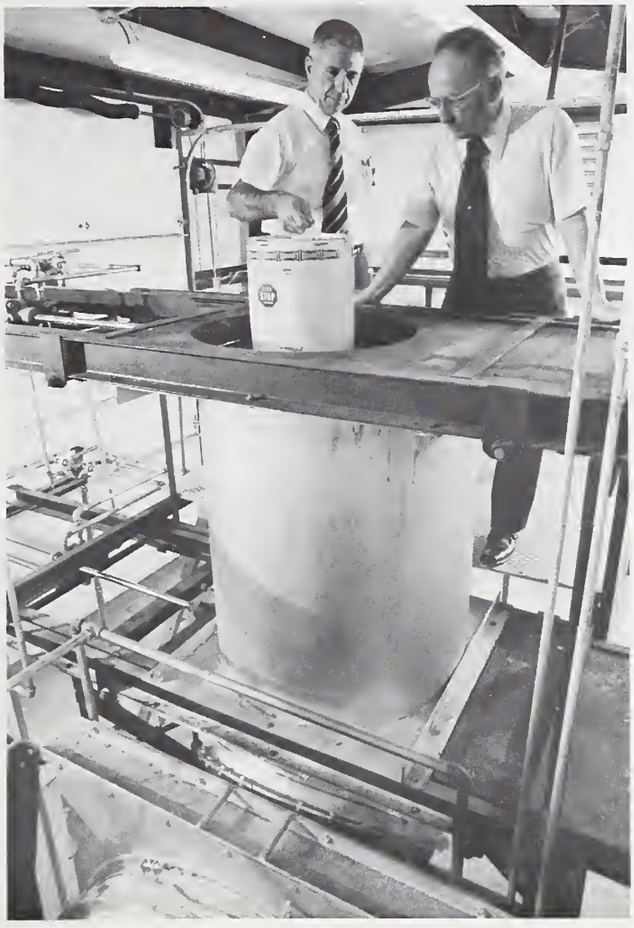
The model incinerator has multiple combustion chambers which allow most of the combustion to take place in the first chamber, while the other chambers insure further combustion of material that escapes the first. This unit can handle both liquids and solids.

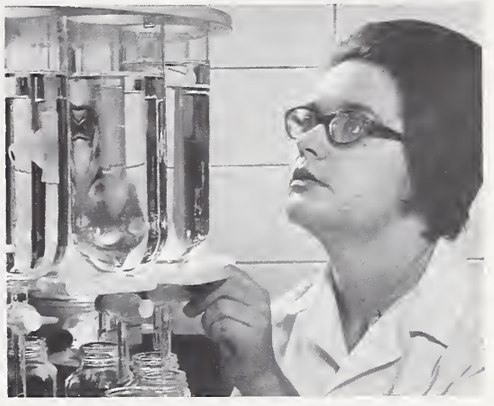
In previous research, the scientists determined that temperatures at or near 1,000° C. (1,832° F.) would be enough to degrade 99 percent or more of most current pesticidal formulations.

The scientists also tried degrading or decomposing pesticides with chemicals and microorganisms. While the results were less satisfactory than destruction by incineration, these methods might prove effective as pre- or post-incineration treatments. They might be used to precondition or partially degrade the chemicals before incineration or to complete degradation after incineration.

Another phase of the project is aimed at finding container materials that would facilitate disposal by incineration. For example, scientists found that at temperatures required for destruction

Left: *A trouble light illuminates the rotary combustion chamber for technician Bruce Bracken as he inspects refractory surfaces for damage and pesticide residue. Protruding blades propel tumbling solids into the stationary combustion chamber (background) to be reduced to minute quantities of ash (1272A1557–2).* ***Below left:*** *Dr. Shuman demonstrates combustion chamber loading procedures for USDA representative Dr. Swanson. Engineers have designed the prototype system to incinerate 200 pounds of dry material, and 13 gallons of liquid pesticide per hour. (1272A1557–23).* ***Below right:*** *Gas samples from the prototype incinerator are extracted by Mississippi State University chemist Foy Hutto to determine if pesticides are present after incineration (1272A1557–8).*





of pesticides, polyethylene, polypropylene and polyvinylchloride are reduced to less than 0.2 percent ash. Paper cartons may be readily incinerated at temperatures acceptable for pesticide incineration, and glass containers will melt and be effectively decontaminated. Metal containers present some different problems. Decontamination by incineration works, but the container itself remains essentially intact.

Scientists point out that the term "disposal" is something of a misnomer. Incineration should be looked upon as a waste reduction process rather than a disposal process. Ultimately, incineration, chemical treatment, and microbial degradation may be used together for a practical, realistic integrated approach. □

Above: *Masked against the potentially toxic gases from a model pesticide incinerator, Dr. Shuman records observations on flame quality. Liquid pesticide disposal studies were made with this unit prior to construction of the prototype incinerator at Stoneville, Miss. (1272A–1554–4).* ***Left:*** *Ash, the non-combustable material remaining following incineration, is monitored by researchers. Here, agronomist Boris J. Stojanovic loads an X-ray spectrograph with an ash sample to determine its elemental composition (1272A1554–17).*

Female medflys respond to a trap used in laboratory bioassays baited with the male sex pheromone. This filter paper wick holds the pheromone and the females are trapped on the sticky coating (PN–2827).

Attracting the female medfly

IT'S DOUBLE TROUBLE for the female Mediterranean fruit fly. The male of the species lures females with two sex attractants.

ARS scientists have identified these attractants and have tested identical synthetic attractants which may prove valuable in detecting and possibly controlling invasions of these major pests of citrus crops.

Mediterranean fruit flies, or medflies, infest citrus in Hawaii and Central and South America. The pest had been eradicated in Florida and Texas, but remains a potential threat to citrus there and in other subtropical regions.

Of several hundred important insect species, less than 40 have sex attractants that have been identified. Most of these attractants are produced by females.

Sex attractants are complex compounds, difficult to analyze. In 3½ years of experiments at Beltsville, Md., chemists Martin Jacobson and William A. Jones employed sophisticated chemical and physical procedures to isolate and identify three tiny droplets of the pure medfly attractants. These droplets were the end product of extracts obtained from 80,000 male medflies reared at the ARS entomology laboratory in Honolulu, Hawaii.

The chemists identified one attractant as an alcohol, *trans*-6-nonen-l-ol, and the other as a related compound, methyl *trans*-6-nonenoate. Each lure is a colorless liquid with a floral odor.

Females responded rapidly to each lure in laboratory tests in Beltsville and Honolulu. However, in field cage tests in Hawaii, the females responded only to traps baited with a mixture of the two lures, plus several acids that males release with the natural attractants. The acids appear to chemically activate the lures.

Experiments are being conducted to determine the optimum proportion of the lures and activating acids for practical application. Entomologist Derrell L. Chambers and chemist Kiichi Ohinata, and technician Martin S. Fujimoto participated in the experiments. □

A NEW USE for hot-water baths, and a modified hot-air treatment gives geranium growers two welcome and much needed additions to the arsenal for geranium rust control.

There are approximately 15,000 greenhouse geranium growers in the United States. Their combined crop is valued at $50–100 million per year. One grower estimates his annual loss from geranium rust at $65,000.

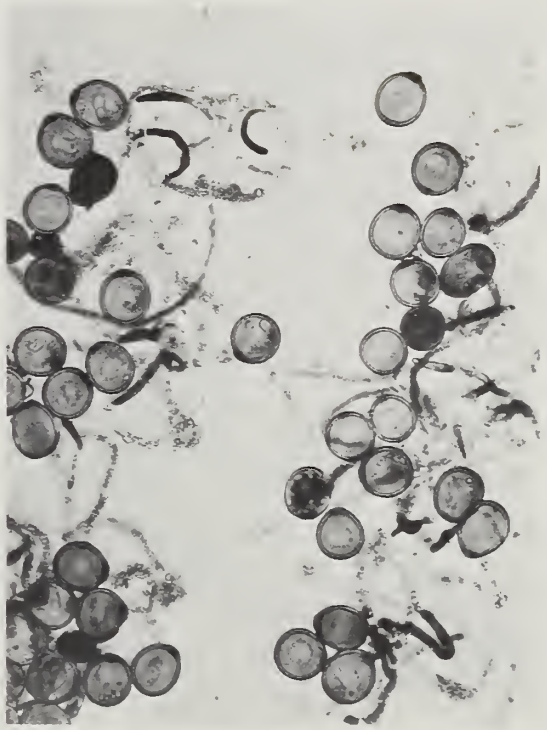
Puccinia pelargonii-zonalis, geranium rust, first reported in California in August 1967, has since been found across the country. Growers fought to protect their field-grown stock plants, using chemical sprays and postharvest, hot-air thermotherapy, but these weapons proved inadequate.

Knowing that other varieties of rust have been effectively controlled by a brief hot water treatment, ARS plant pathologist Douglas J. Phillips, Fresno, Calif., and plant pathologist Arthur H. McCain, University of California at Berkeley, tested this method's effectiveness in controlling geranium rust.

In four tests, the researchers treated cuttings (600 per test), either naturally infected or innoculated with geranium rust, in one of three ways: with water-saturated air at 100° F. for 24 or 48 hours; with hot water at 122° or 125° F. for 90 seconds; or with hot water at 115° F. for 90 seconds.

Hot air treatments were conducted in a forced-air, controlled temperature and humidity chamber. Plants for hot water treatments were loosely packed in wire baskets and immersed in an insulated, stainless steel tank containing about 75 gallons of hot water. A controller equipped with a thermistor probe maintained temperatures, and water

Hot baths heal geraniums



Above: Rust pustules on geranium leaves. Note halo or target aspect of pustules (PN–2823). ***Top right:*** *Urediospores on untreated plants (PN–2824).* ***Bottom right:*** *A cross section through a rust pustule on a geranium leaf (PN–2822).*

was circulated constantly during treatments. Plants cooled in air for 10 minutes after each treatment.

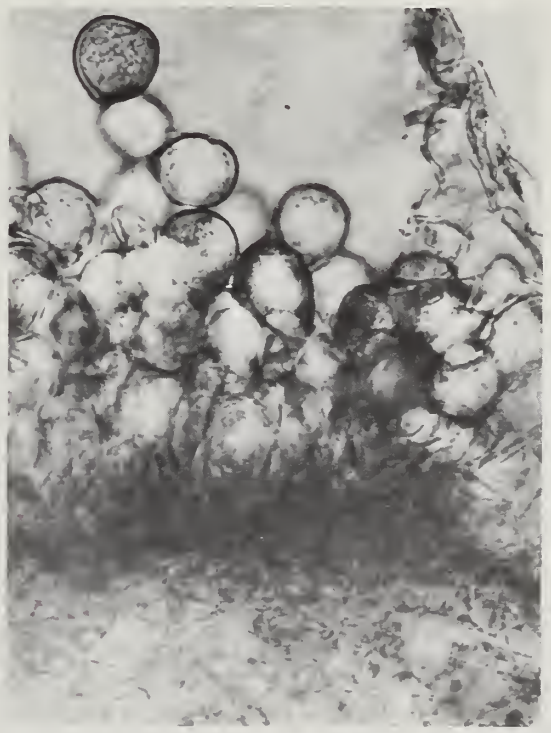
Following treatments and one day in transit, the researchers planted the cuttings in pots arranged in randomized block designs in a greenhouse. The researchers then regulated the temperature at 77° F. (plus or minus 10° F.) and watered the plants twice daily. After 3 to 5 weeks they recorded rust incidence and heat-related damage.

Test results look good. No rust developed on plants treated from 24 to 48 hours in 100° F. hot air, or for 90 seconds at 122° or 125° F. hot water. Nontreated plants kept under identical conditions during the tests did develop rust. Treatments at 115° F. did not adequately control rust and increased the incidence of stem rot.

Long hot-air treatments caused little or no heat damage, while plants dipped in hot water suffered 0 to 50 percent damage, but injuries were more or less confined to the petiole and main veins of expanding leaves, and cuttings continued to grow and develop normally.

Growers may be reluctant to add water to geranium cuttings because of the problems associated with "wet" cuttings for other ornamentals; however, hot-water treatments eliminate or reduce many of these problems. Initial observations do show that free water should be reduced before shipping the hot-water treated cuttings. Handling and shipping tests are underway using hot-water treated geranium cuttings to learn the effects of hot water therapy on cutting quality during transit.

For now, however, hot-air treatment or a hot-water dip, used in conjunction with a good rust control program that minimizes inoculum density on the mother plant, provides an effective and proven means to protect geraniums from rust. □



Citrus grading by automation

AUTOMATION could reduce costs and improve the consistency of grading so that citrus fruit on the market would be of more uniform quality. This goal could be achieved because citrus fruit possesses light reflectance characteristics which make the use of automated optical grading equipment possible.

Official Florida citrus fruit grade standards, established so that fruit reaching the consumer is free of decay, has good color, and is free of skin blemishes, are only as effective as the people or devices doing the grading. In a typical citrus packinghouse, a large number of workers sort out fruit that does not meet the grade standards. Unfortunately, manual grading is subject to human error, and the cost is high.

One technique which might be used for automatic grading would be measuring the amount of light reflected from skin defects as compared with the amount reflected from the normal fruit surface.

The same technique could also be used for color sorting if the differences in the amounts of reflectance from fruit or different color levels are consistent at a particular wavelength or combination of wavelengths. With this in mind, ARS agricultural engineer Jerome J. Gaffney, Gainesville, Fla., studied light reflectance characteristics of citrus fruit.

Using a double-beam recording spectrophotometer with a reflectance attachment, the researcher measured an area of $\frac{5}{16}$ by $\frac{7}{8}$ inches on the surface of each fruit. The instrument recorded the amount of light reflected from defects on each sample as compared to a reference standard.

Curves charted from the recorded reflectance values show at certain wavelengths, a reflectance difference of at least 15 percent between defective and normal fruit surfaces. This is an adequate difference for sorting. Usually, the defective surfaces reflected less light than normal fruit surfaces. In a few instances the defective surface gave greater reflectance. Such is the case for a plug, an injury to fruit where improper picking removes a portion of the peel at the stem end.

Fruit samples tested included three varieties of oranges, three varieties of grapefruit, Temples, tangelos, tangerines, and lemons. For each variety of fruit tested a single wavelength band was found that could be used for detecting differences between the various defects and the normal fruit surface. The results indicate a good potential for the design of automatic optical grading equipment for citrus.

In general, the reflectance curves recorded by the researchers are quite representative of major defects for each particular citrus variety or kind tested. Some defects which may occur on citrus however, were not studied. Also, how widely the reflectance between different samples of the same type of defect may vary is unknown. Therefore, wavelength bands indicated in the study as suitable for sorting defects on citrus are not necessarily the best for every application.

The grade standards allow for a small percentage of misgraded fruit. It is not necessary, therefore, for a machine to do a perfect sorting job. □

Bulk handling speeds grape harvest

About 90 percent of the U.S. Concord grape crop was harvested mechanically in 1972. Harvesting machines are now widely used for juice grapes in Michigan, New York, Pennsylvania, and other States.

Harvesters have been developed that work efficiently, without damaging the fruit. To realize their full benefit, however, growers need new handling systems capable of moving the fruit faster to processing plants.

Such a system for Concord grapes has been worked out by ARS agricultural engineers Dale E. Marshall and Jordan H. Levin at East Lansing, Mich., and Burt F. Cargill of Michigan State University, in collaboration with grape growers and farm machinery manufacturers.

Grape harvesters are large machines. They ride through the vineyard, straddling the vines and shaking them with flexible arms or spiked wheels. The detached grapes fall inside the machine, where air currents remove leaves, stems, and other debris. Then the grapes are elevated on a belt conveyor into a trailer.

In the new handling system developed by ARS engineers, self-dumping trailers take the grapes to bulk tank trucks in the field, which haul the crop to the processing plant. There, the trucks back up to a receiving hopper, upend their load hydraulically, and pour out the grapes.

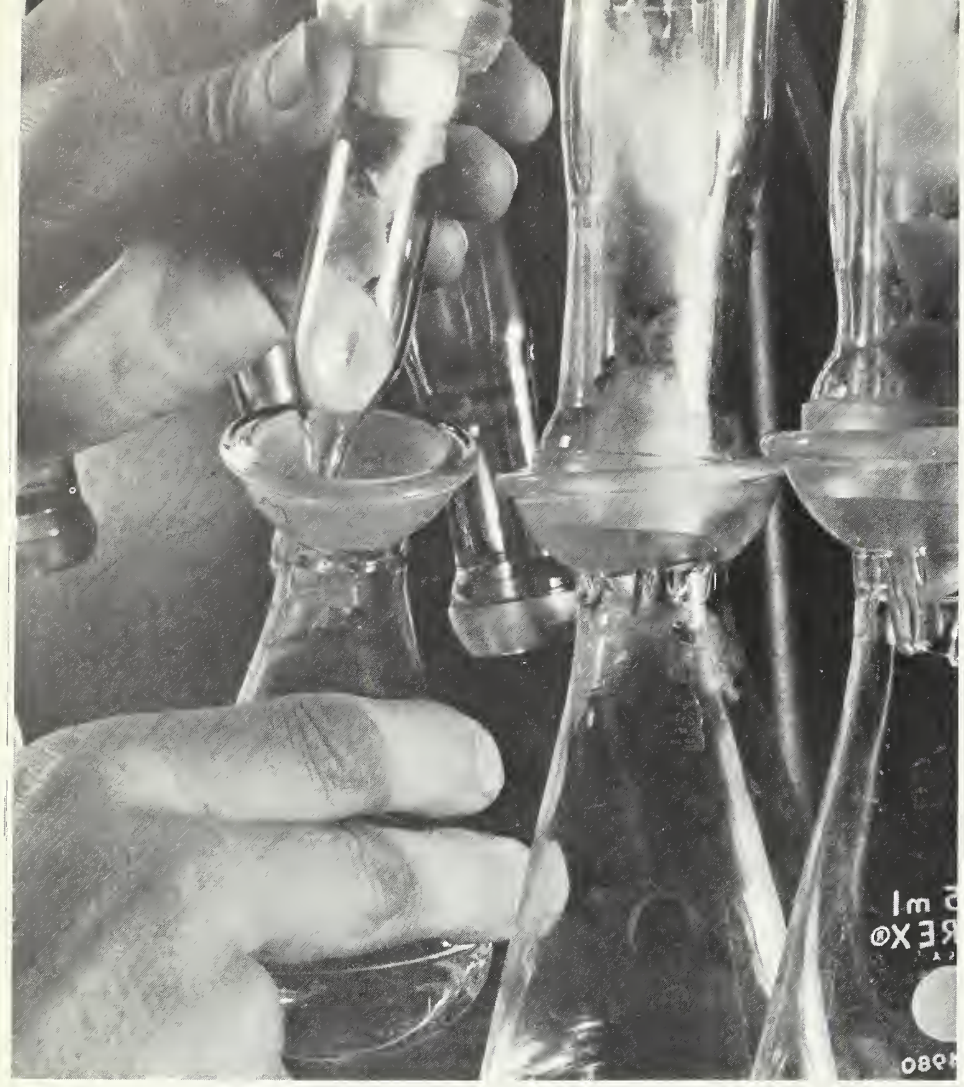
Getting grapes from vineyard to processor is thus faster and less laborious than it used to be. The new system eliminates old style plastic lugs and pallet boxes. It was used in Michigan to handle nearly 2 million pounds of Concord grapes in 1970, and over 5 million pounds in both 1971 and 1972.

Chemists at the ARS Eastern regional research laboratory in Philadelphia have also contributed to the new era in grape harvesting. They are concerned with the quality of juice made from bulk-handled fruit. A key to this problem was provided by the late Robert T. Whittenberger, who devised a method for testing the quality of juice produced from sample lots of grapes.

Both laboratory and taste-panel tests indicate that juice made from mechanically harvested grapes compares favorably in color and flavor with that made from handpicked grapes and with commercial grape juice.

Research at the Philadelphia laboratory to insure high quality in products made from mechanically harvested crops is now the responsibility of chemists Claude H. Hills and Winfred O. Harrington. They find that juice yield, as well as quality, is similar in machine- and hand-harvested grapes. There is also less trash (stems and leaves) when the crop is gathered mechanically. □

This 2-ton capacity hydraulic dumping trailer receives the grapes from a mechanical over-the-row grape harvetser. When the trailer is full, it pulls alongside an 8-ton capacity bulk tank mounted on a flat bed truck and dumps its load (BN–39750).



Far left: *Small pieces of cooked tissue from test animals are extracted to obtain pure samples of fat. Analyses through gas chromotography will determine the amount of polyunsaturated fat in each sample (1272A1549–16).* ***Left:*** *Dr. Dinius measures prescribed amounts of formaldehyde-protected casein oil into feed (1272A1550–7).* ***Bottom right:*** *Printed data from gas chromotography reveals relative amounts of saturated and unsaturated fat from each pure sample analyzed. Here, agricultural technician Banner Phillips and Dr. Dinius discuss findings (1272A1549–7).*

Unsaturated fat in beef?

Can cattle be bred or fed to lessen the proportion of saturated fats in their meat? Scientists hope to answer this question soon, especially in view of public concern that saturated fats may contribute to heart disease.

So far, medical evidence seems to support the contention that substituting polyunsaturated fats for the saturated fats found in meat, milk, and eggs tends to lower blood-serum chloresterol and reduce the risk of heart and circulatory ailments.

Future medical research may or may not justify present concern over saturated fats. In the meantime, agricultural scientists at Beltsville, Md., are looking for ways to lower the concentration of these fats in beef.

Ruminant nutritionist David Dinius, physiologist Theron S. Rumsey and nutritionist Robert R. Oltjen are studying the effects of different feeding regimes and breeding systems on carcass fat composition. They are also testing the effects of feeding beef animals unsaturated vegetable oil as a means of reducing saturated fat in meat.

Scientists have known for several years that the amount of saturated fats in the carcasses of sheep and beef is somewhat lessened when the animals are fed high-concentrate rations consisting of large amounts of grain. However, livestock rations composed mainly of grain may not be practical in the future, because human demands for grain proteins may take precedence. Then cattle feeds may have to be restricted largely to hay and other roughage which man cannot use directly.

To study the effects of roughage vs. concentrate on carcass fat composition in cattle, 48 Hereford steers were divided into 4 groups and fed as follows: Group C received an all-concentrate ration for the length of the experiment; Group F received an all-forage ration of pelleted hay; Group CF was fed concentrates during the first half of the experiment (77 days) and forage the second half; and Group FC was fed roughage the first half and concentrates the second half.

Group C was slaughtered after 168 days on the all-concentrate ration. The other cattle were fed until they reached the same slaughter weights as those of Group C. These weights were reached after 180 days in Group FC; 196 days in Group CF; and 203 days in Group F.

As expected, cattle fed the all-concentrate ration had the highest levels of unsaturated fats in their carcasses. However, steers of both the FC Group (fed forage first and concentrate last) and the CF Group had carcasses similar in unsaturated fats to those of steers fed the all-concentrate ration. The levels of unsaturated fats in cattle fed the all-forage ration were significantly lower than those in Groups C, CF, and FC.

These results indicate that finishing beef steers on forage for half of the feeding period and an all-concentrate ration for the other half, will produce beef with about the same level of unsaturated fats as that usually found in steers finished entirely on concentrates. Previous studies had shown that steers will gain satisfactorily on forage rations. However, corn or other grains may be more economical than forage in many parts of the country. Moreover, most feedlots are better equipped to feed concentrates.

To determine whether the level of unsaturated carcass fat is affected by genetic background or selection for growth, Dr. Rumsey studied 22 Angus and 22 Shorthorn cattle from a long-term breeding project. Fat samples were taken from one growth line and four inbred lines. The inbred lines were established from different genetic bases.

The Shorthorns had less saturated fat in both the growth and inbred lines than the Angus, though the differences were small. Selecting for growth did not influence the level of saturated fat, but there was a significant difference in the level of unsaturated fatty acids among inbred lines.

Dr. Rumsey believes there is some genetic potential for increasing unsaturated fats in cattle, especially if breeding for this purpose is combined with a feeding program to reduce levels of saturated fats in the animals.

However, the greatest changes in carcass fat composition are likely to be brought about by feeding "protected" polyunsaturated oils to cattle. This conclusion comes from preliminary results at Beltsville. Previous ARS studies had shown that the same method could increase polyunsaturated fats in milk (AG. RES. March 1972).

If liquid polyunsaturated oils are fed to cattle, reactions inside the rumen saturate the oils. To prevent this, the oils can be "protected." This is done by mixing the oil with casein (milk protein), then spray-drying the mixture, and finally treating the oil-casein powder with formaldehyde. This assures passage of the oil through the rumen in an unsaturated state.

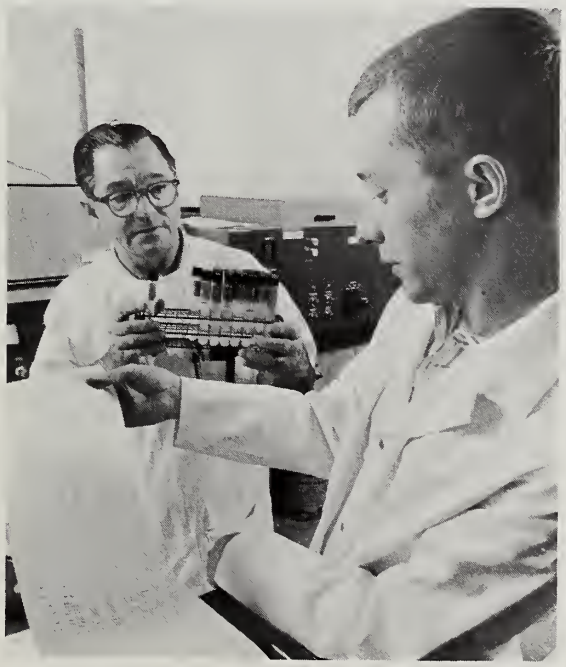
Dr. Oltjen fed 16 steers five different rations containing highly unsaturated safflower oil. Ten percent of one ration and 20 percent of another contained the formaldehyde-protected casein-oil mixture. Two other rations also contained 10 or 20 percent of a casein-oil mixture, but in these cases it was not protected by formaldehyde.

A fifth ration, containing casein without oil, was fed to a control group.

Steers were kept on the above rations for six weeks and then slaughtered. The carcass fat from steers fed the formaldehyde-protected casein-oil mixture at the 20-percent level had 18 percent linoleic acid compared to 2 percent linoleic acid for steers fed the unprotected oil. Steers fed the protected mixture at the 10-percent level had 13 percent linoleic acid. Linoleic acid is an unsaturated fatty acid and a normal component in carcass fat. It is often used as an index of fat saturation.

A taste panel rated meat from all carcasses equal in flavor, tenderness, and juiciness.

Further studies on the carcasses are being made to determine whether meat with less saturated fat will make satisfactory sausage, hot dogs, and other products. Studies are planned also to see what happens to blood-serum cholesterol when meat with less saturated fat is consumed by rats or humans. □



AGRISEARCH NOTES

Marek's vaccine gets a boost

A LABORATORY TECHNIQUE for producing the vaccine that protects chickens against Marek's disease increases output per cell culture as much as 30 times over the yield of the conventional method.

The cost of the vaccine now is high because of the low yield of virus from cell culture and the elaborate techniques necessary to preserve the virus and administer it to chickens. The new technique, which could easily be adapted to commercial use, would reduce the cost.

Laboratory and field trials have demonstrated the purity, potency, and effectiveness of a herpesvirus isolated from turkeys in preventing Marek's disease (AGR. RES., Jan. 1970).

The technique was developed by veterinarian Cellidonio Garrido of the Laboratorio de Patologia Aviaria, Cuidad Obregon, Mexico, and microbiologist William Okazaki, veterinary medical officer H. Graham Purchase, chemist Lucy F. Lee, and biologist Ben R. Burmester, all of ARS, Regional poultry research laboratory, East Lansing, Mich.

The new virus-production method is based on the fact that the number of cells growing on a surface can be greatly increased by addition of cells to an already established monolayer. Most of the added cells settle down and grow among the cells already present,

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forming a layer several cells thick. The virus is currently produced by a monolayer cell culture technique.

The scientists established cell cultures prepared from embryonated Pekin duck or chicken eggs and infected the cultures with cell-associated herpevirus of turkeys. Just before visible signs of cell damage reached their maximum, they added more cells to the culture. Yield of virus was determined daily, beginning on the first to fourth day after infection. Maximum yield was obtained 1 to 3 days after addition of uninfected cells to the culture.

Protecting against bagworms

A MICROBIAL INSECTICIDE, *Bacillus thuringiensis,* can reduce bagworm damage on evergreen trees, as effectively as a currently recommended chemical insecticide.

Biological control provided by *B. thuringiensis* may become especially useful in protecting ornamentals in nurseries in expanding urban areas. The safety of the non-hazardous organism would probably offset and justify its cost which is slightly higher than the chemical insecticide.

William H. Kearby, University of Missouri entomologist, in cooperation with ARS entomologists Donald L. Hostetter and Carlo M. Ignoffo, Columbia, Mo., sprayed a commercial formulation of *B. thuringiensis* on white pine trees which had been lightly to heavily defoliated by the insect. During the bagworms' springhatch period an application of the organisms, in a mixture of molasses and activated carbon (IMC–515), increased viability of the bacteria exposed to sunlight. The level of viable spores per gram of pine needles increased as the application rate of bacterial suspension increased from 5 to 21 milliliters per tree. The commercial formulation contained at least 6 billion viable spores per gram.

In laboratory tests, weighing of fecal pellets from larvae that were fed treated foliage for 10 days, clearly demonstrated that *B. thuringiensis* does inhibit feeding. In field tests, mean gramweight of foliage per 12-inch branch was higher on trees treated with the bacteria than with those treated chemically. Reduction of bagworm population was slightly less extensive in the bacterially treated trees. When feeding damage was considered, there was no statistical difference between optimum doses using bacterial or chemical controls.

More lambs from Finnsheep crosses

CROSSBRED FINNSHEEP EWES are more efficient at producing a lamb crop than crossbred Rambouillet ewes.

Comparisons were made between these two crosses at the U.S. Meat Animal Research Center, Clay Center, Nebr.

Finnsheep were introduced into this country in 1968. In their native Finland, Finnsheep are known to produce up to five or more lambs per ewe, per year, with an average of over three. In the United States, an average of only one lamb per ewe is marketed each year from our domestic breeds. Scientists hope that by incorporating Finnsheep blood lines into our native breeds, the lambing rate can be increased. Moreover, Finnsheep can be bred to lamb as yearlings and do an effective job of raising their young. Later-maturing domestic breeds do not usually lamb until they are 2-year-olds.

In studies with Finnsheep and Rambouillet crossbred ewe lambs, 72 percent of the Rambouillet crossbred ewes lambed as compared to 94 percent of the Finnsheep crosses. The Finnsheep crossbred ewes had a 135 percent lamb crop weaned per ewe exposed to the ram and the Rambouillet crosses only 72 percent. This meant over 80 percent more lambs weaned from the Finnsheep crossbred ewes.

Preliminary results indicate that these Finnsheep crossbred ewes as 2-year-olds will approach a 200 percent lamb crop.